

## TABLE OF CONTENTS

3	Policy and System Management Components.....	113
3.1	Lake Okeechobee.....	113
3.1.1	Introduction.....	113
3.1.2	Lake Okeechobee Water Budget .....	114
3.1.3	Lake Management Processes .....	115
3.1.4	Lake Interaction with the C-43 and C-44 Basins/Estuaries .....	124
3.1.5	Lake Management Algorithm .....	127

## LIST OF FIGURES

Figure 3.1.1.1	Lake Okeechobee Stage-Area-Storage Relationships .....	114
Figure 3.1.3.1	Lake Okeechobee Run 25 Regulation Schedule .....	116
Figure 3.1.3.2	WSE Regulation Schedule .....	121
Figure 3.1.3.3	WSE Decision Tree for Lake Okeechobee Discharges to WCAs .....	122
Figure 3.1.3.4	WSE Decision Tree for Lake Okeechobee Discharges to C-43 and C-44s .....	123
Figure 3.1.4.1	Schematic Diagram of Caloosahatchee Basin/Estuary Simulation Module.....	125
Figure 3.1.4.2	Schematic Diagram of St. Lucie Basin/Estuary Simulation Module .....	127

## LIST OF TABLES

Table 3.1.3.1	Lake Okeechobee Operations in the South Florida Water Management Model .	117
Table 3.1.3.2	Classification of Tributary Hydrologic Regimes.....	119
Table 3.1.3.3	Classification of Seasonal and Multi-Seasonal Inflow Predictions .....	120
Table 3.1.3.4	Pulse Release Hydrographs for the Three Levels of Zone D Regulation Schedule for Lake Okeechobee .....	122

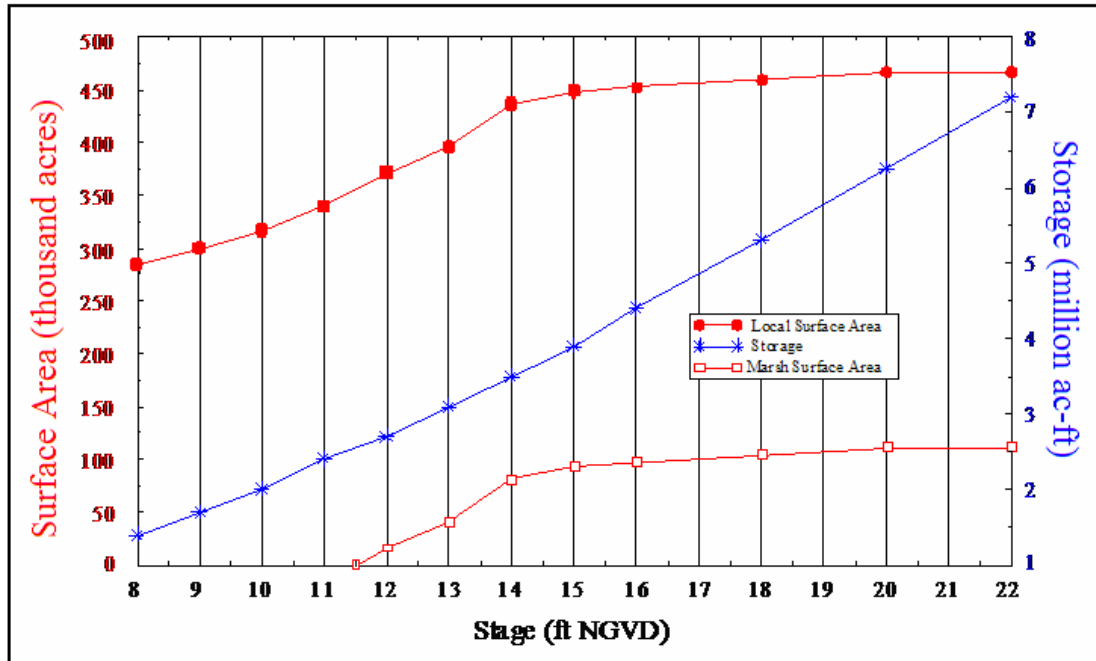
### **3 POLICY AND SYSTEM MANAGEMENT COMPONENTS**

In general, the task of describing the policy and system management components as implemented in the South Florida Water Management Model (SFWMM) is a difficult one. The complexity evident in the makeup of the South Florida regional system in combination with the specificity often associated with local and regional system management policies can lead to an overwhelming amount of detail in the description of the system and the means by which it is modeled. This complexity, in conjunction with the consideration that the SFWMM must be able to simulate all aspects of current and future proposed operational and infrastructure alternatives, makes it difficult to balance the desire to achieve both a comprehensive and a concise representation of SFWMM modeling capability. To help address this limitation, the approach utilized in the subsequent sections is to provide a general explanation of model methodologies and features on an area-by-area basis followed by specific examples of how model capabilities are applied to real-world or hypothetical examples.

#### **3.1 LAKE OKEECHOBEE**

##### **3.1.1 Introduction**

The name "Okeechobee" was derived from the Seminole Indian words "Oki" (water) and "Chubi" (big), and appropriately translates into "big water." Lake Okeechobee (LOK), the second largest freshwater lake lying entirely within the continental United States of America, occupies a surface area of approximately 728 square miles and has an average depth of 9 feet. Figure 3.1.1.1 shows the stage-area-storage relationships for Lake Okeechobee. The primary uses of Lake Okeechobee water include: (1) agricultural water supply to the Lake Okeechobee Service Area (LOSA); (2) backup water supply and prevention of saltwater intrusion to the Lower East Coast Service Areas (LECSAs); (3) water supply to adjacent municipalities (Belle Glade, Pahokee, Clewiston and Moore Haven); (4) use as a bird and wildlife feeding ground; (5) recreational uses (e.g., fishing and boating); and (6) environmental water supply to downstream ecosystems including the Caloosahatchee and St. Lucie Estuaries and the remnant Everglades. Lake stages are controlled for the purpose of: (1) environmental protection and enhancement of the Lake littoral zone (vegetation zone along the peripheral Lake areas) and the Everglades; (2) flood protection of adjacent areas; (3) water supply to agricultural and urban users; and (4) protection of the St. Lucie and Caloosahatchee Estuaries. The primary inflows to Lake Okeechobee are the Kissimmee River, Fisheating Creek, Taylor Creek/Nubbin Slough, Indian Prairie and Harvey Pond Canals. Its primary outlets are the Caloosahatchee River, St. Lucie River, Miami Canal, North New River Canal, Hillsboro Canal, West Palm Beach Canal and L-8 Canal.



**Figure 3.1.1.1** Lake Okeechobee Stage-Area-Storage Relationships

### 3.1.2 Lake Okeechobee Water Budget

In the SFWMM, Lake Okeechobee is simulated as a lumped hydrologic system as contrasted to the majority of the model domain where a distributed system of 2-mile by 2-mile grid cells is used (refer to Section 1.3). There is only one water level that is associated with the Lake at any given time step. For each daily time step the water budget equation is solved for Lake Okeechobee. This equation relates the change in storage within the Lake as a control volume, and incoming and outgoing flows for the same control volume. Mathematically, Lake hydrologic components (rainfall, evapotranspiration and seepage) and managed flows (structure discharges) account for changes in Lake storage. Rainfall and evapotranspiration are discussed in detail in Sections 2.2 and 2.3. Net levee seepage and regional groundwater movement in the Lake are assumed to be small relative to the other hydrologic components of the Lake water budget and are, therefore, not calculated in the model. Studies by Meyer and Hull (1969), and Shaw (1980) indicate that seepage rates range from 0.1 to 0.9 cfs/mile/ft. Runoff inflows generated from surrounding tributary drainage basins are discussed in Section 2.7. A generalized form of the Lake Okeechobee storage change equation (neglecting levee seepage and regional groundwater flow) can be written as:

$$S_{t+1} = S_t + \text{Inflows}_t - \text{Outflows}_t \quad (3.1.2.1)$$

where:

$S_{t+1}$  = storage in the Lake at the next time step [ac-ft];

$S_t$  = storage in the Lake at the current time step [ac-ft];

$\text{Inflows}_t$  = volume flux into the Lake (e.g. rainfall, structure discharge) during the current to the next time step [ac-ft]; and

$\text{Outflows}_t$  = volume flux out of the Lake (e.g. evapotranspiration, structure discharge) during the current to the next time step [ac-ft].

Management rules or operational policies dictate the amount, spatial distribution and timing of discharges through all Lake water control structures which, in turn, determine the variation of Lake storage. Given Lake storage, the corresponding Lake water stage and surface area can be obtained via the stage-area-storage relationship previously presented.

### **3.1.3 Lake Management Processes**

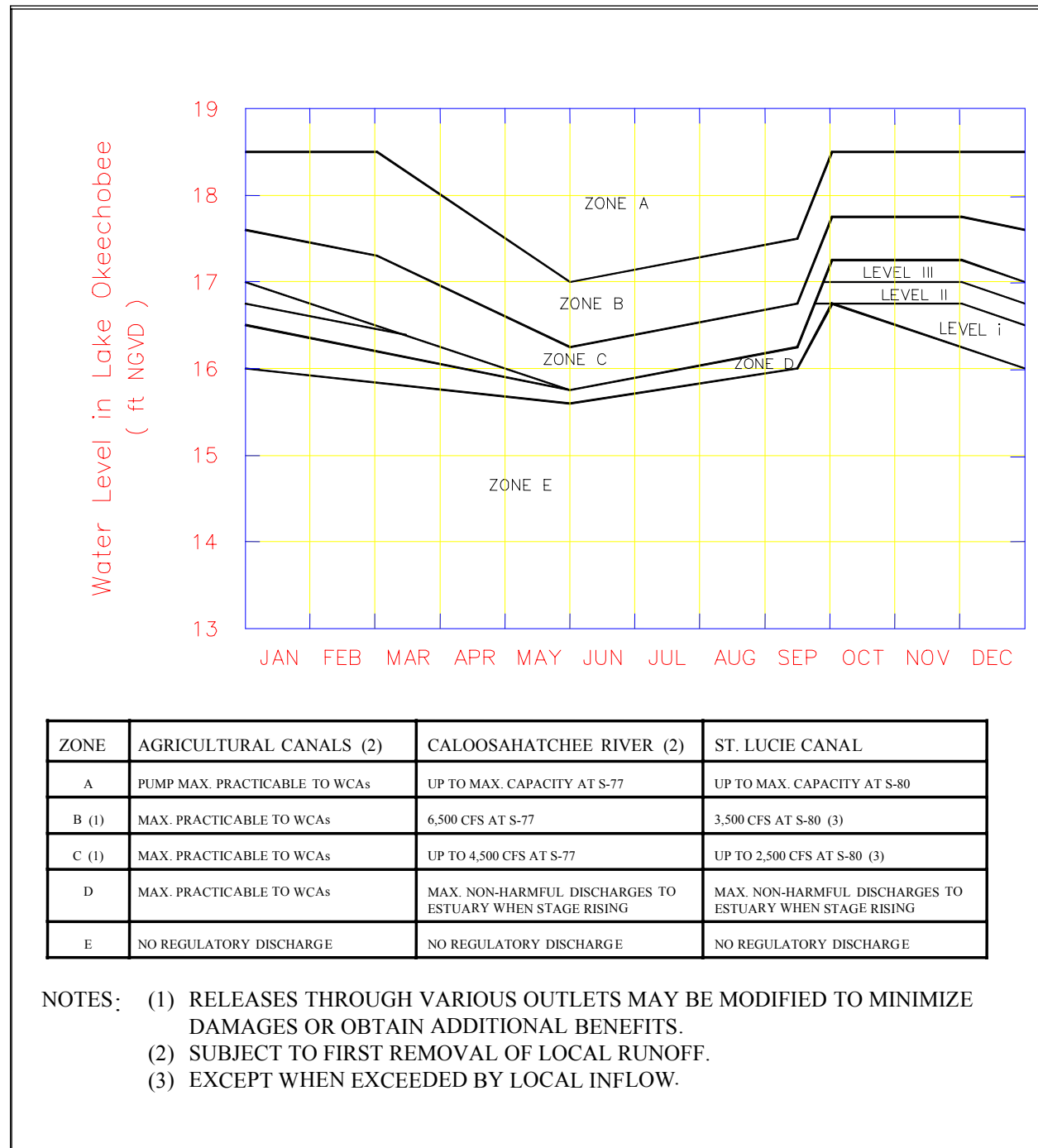
High water levels in Lake Okeechobee are managed through regulatory and non-regulatory releases. Regulatory releases are made according to a calendar-based regulation schedule, established by the U.S. Army Corps of Engineers (USACE) in conjunction with the SFWMD and other public entities, to ensure that the integrity of the peripheral levee encompassing Lake Okeechobee is not compromised due to high water levels. The regulation schedule is designed to have minimum impact on the downstream ecological systems whenever possible while continuing to meet the flood control criterion. Regulatory releases can be made through the St. Lucie Canal and/or the Caloosahatchee River to tide water or through the Water Conservation Areas (WCAs), if this can be accomplished with minimum impact to the Everglades natural systems. Non-regulatory releases are sent to areas of the system for a myriad of purposes including irrigation, saltwater intrusion control, domestic water supply and environmental enhancement. Additionally, in the future, Lake Okeechobee discharges will be made to many of the proposed storage features (including above ground reservoirs and Aquifer Storage and Recovery facilities) to be constructed in the vicinity of the Lake. Several regulation schedules have been used for Lake Okeechobee in the past and flexibility is incorporated in the SFWMM to simulate several different alternatives.

In general, there are two distinctly different approaches to Lake management available in the SFWMM. The first type represents a time-dependent, trip-line operation where management decisions are on-off and clearly defined. The second type represents a time-dependent, climate-based operation where operational flexibility is included to account for predicted weather patterns. The use of climate forecasts in the simulation is achieved by pre-processing time series inputs of non-perfect forecasts of Lake inflow aggregated over various prediction windows (e.g. six to twelve months). The simulation checks the forecast daily, but the forecast is updated monthly. The forecast is produced using one of several estimation methodologies that rely on regional, global, and solar indicators which are useful tools for assisting operations, and for estimating inflows to Lake Okeechobee (Trimble, et al. 1997).

As an illustrative means of demonstrating the types of capabilities that are available to SFWMM users, two different regulation schedules will now be outlined. The Run 25 Regulation Schedule represents the trip-line type of operation – if the Lake level passed a regulation line, action was taken. It was used for real-time operations from 1993 to 2000. In 2000, the Water Supply and Environment (WSE) Regulation Schedule was implemented for Lake Okeechobee which represents a broader scope in determining operations. Climatic influences, both local and global, were included in WSE (Trimble, et al. 1998).

Under Run 25, water levels in Lake Okeechobee are managed through regulatory (flood control) and non-regulatory (primarily water supply) releases. The regulatory level for Lake Okeechobee

ranges from 15.65 ft NGVD in late May to 16.75 ft NGVD on October 1. Table 3.1.3.1 summarizes the generalized operational rules governing Lake Okeechobee as implemented in the model for Run 25. The order by which the release type is presented in this table determines the sequence of deliveries as simulated in the model. The summary of the Run 25 regulatory rules as set forth by the USACE is given in Figure 3.1.3.1. As shown in the figure, regulatory releases are primarily conditioned on Lake stage falling above one of the calendar-based trigger lines.



**Figure 3.1.3.1** Lake Okeechobee Run 25 Regulation Schedule  
 (Adapted from U.S. Army Corps of Engineers).

**Table 3.1.3.1 Lake Okeechobee Operations in the SFWMM**

RELEASE TYPE	TRIGGER	ACTION/S	DESTINATION	EXCEPTION/S	SUBROUTINES USED
<b>CONSUMPTIVE USE WATER SUPPLY:</b>					
EAA, L8 and S236	Volumetric based on crop ET requirement	LOK supplements rainfall and local storage to meet total ET requirements	EAA and L8 via S354, S351, S352 & Culvert 10A; S236 Basin via S236	Delivery is subject to supply side management criteria (Section 3.3) and structure capacity limitations	AGAREA –SSM EAACOR EAA_FLOW_DIST_CAPAC_SETUP ALLOC_TO_EAA CANL_DEP_STRUC_PARAM_SETUP GEN_DEP_STRUC_CAPAC_SETUP SPEC CANL DEP_STRUC_FLW
Lower East Cost (Domestic use, Industrial use, Agricultural use)	Net LECSA demands minus WCA contribution	LOK as back-up source. Delivery occurs when available water in WCA is less than demand in LEC service area	LEC service areas via EAA and WCA conveyance systems	If runoff from EAA sufficient to meet LEC demands	AGAREA WSNEEDS LAKE_NONREG_WCA LAKE_REG_WCA
Other LOSA basins including C43, C44, S4, etc...	Demand time series	Volumetric transfer from LOK considering conveyance limitations	Other LOSA Basins	Delivery is subject to supply side management criteria (Section 3.3) and structure capacity limitations	SSM CALOOS STLUCIE LAKE_NONREG_WCA LAKE_REG_WCA
<b>ENVIRONMENTAL WATER SUPPLY:</b>					
Everglades	NSM (or other) stage targets	If simulated stage at trigger location(s) is less than target stage(s), deliver water at maximum available capacity	<ul style="list-style-type: none"> <li>WCA-3A via Miami Canal first, then NNRC if desired</li> <li>WCA-2A via Hillsboro Canal</li> <li>WCA-1 via WPB Canal</li> </ul>		MAIN LAKE_NONREG_WCA LAKE_REG_WCA
Estuary	Demand time series	If estuary demands exceed local basin runoff, supplement water to meet remaining demand	Caloosahatchee and/or St. Lucie Rivers		CALOOS STLUCIE
<b>STORAGE INJECTION (ASR OR ABOVE-GROUND RESERVOIRS)*:</b>					
	LOK stage adjusted for water supply releases, and adjusted LOK stage compared with storage injection line	Deliver water to associated reservoir & ASR(s)	Appropriate reservoir, Deliver to RES/ASR systems in EAA first, then to Caloosahatchee, St. Lucie or North Storage.	If LOK stage below user input storage injection schedule line; subject to conveyance capacity and available storage in reservoir / ASR.	ASR-INPUT LARGER_RESERV_STOR LAKE_NONREG_WCA LAKE_REG_WCA RESOUT ASR RESASR_SIM

**Table 3.1.3.1 (cont.)** Lake Okeechobee Operations in South Florida Water Management Model

RELEASE TYPE	TRIGGER	ACTION/S	DESTINATION	EXCEPTION/S	SUBROUTINES USED
<b>REGULATORY:</b>					
	LOK stage adjusted for water supply releases, and storage injection, if applicable	Delivery of water according to schedule operational rules	1. WCAs Basins: a. WCA-1 via WPB Canal b. WCA-1 via Hillsboro Canal c. WCA-2A via NNR Canal d. WCA-3A via Miami Canal (sequence can be specified by user) 2. Caloosahatchee & St. Lucie Estuaries	Dry Season (to the south): if demand in EAA exceeds conveyance capacity; or if runoff exceeds operational capacity  Wet Season (to the south): if runoff or demand in EAA exceeds operational capacity or Everglades does not need water (optional)	LAKE_NONREG_WCA LAKE_REG_WCA

\* Only used when these components are simulated in a particular scenario.

The WSE schedule shares many of the same features as Run 25 from the perspective of non-regulatory water supply and storage injection considerations. Many of the fields outlined in Table 3.1.3.1 are applicable to both schedules. However, in contrast to Run 25, the WSE schedule requires several additional criteria checks besides Lake stage in determining whether conditional regulatory releases are made. Figure 3.1.3.2 illustrates the WSE Operational Schedule. Figures 3.1.3.3 and 3.1.3.4 delineate operational decision trees that detail the implementation of the WSE schedule. Additional decision criteria that are part of the WSE schedule (diamonds in the decision tree; Figure 3.1.3.3 and 3.1.3.4) and their modeled implementation can be described as follows:

**Lake Okeechobee Water Level Criteria** – Lake water levels are checked against the defined operational zones. Depending on which zone simulated Lake stages fall after adjusting for water supply and storage injection discharges, the additional criteria as defined in the decision tree are applied.

**Tributary Hydrologic Conditions** – This index helps to determine when there is an opportunity to 'hedge' water management practices. For example, if tributary conditions are wetter than normal (and as a corollary higher inflow to Lake Okeechobee is expected), it may be appropriate to more aggressively release regulatory discharges in order to minimize the potential of adverse impacts later (e.g. high Lake stages). Two measures of the tributary hydrologic conditions are included within the design of the operational decision tree: 1) Lake Okeechobee tributary basin excess or deficit of net rainfall (rainfall minus evapotranspiration) during the past thirty days and, 2) the average S-65E inflow for the past two weeks. Each measure is updated on a weekly basis. Table 3.1.3.2 summarizes the ranges of the net rainfall and two-week average flow as they were selected in the original WSE Environmental Impact Study (EIS) to represent the various hydrologic regimes. The wettest classification of the two regional hydrologic indicators is selected to represent the hydrologic conditions in the tributary basin to ensure that flood protection criteria are being met. Therefore, if net rainfall indicates wet conditions but S-65E flow indicates normal conditions, the operational condition will be taken to be 'wet'. In the SFWMM, weekly pre-processed time series data is input and user input options define the thresholds for classification of tributary conditions. It is interesting to note that during the development of the WSE schedule, the SFWMM was one of the primary tools for testing classification schemes to determine the best threshold values for meeting regional hydrologic performance measures.

**Table 3.1.3.2** Classification of Tributary Hydrologic Regimes

<b>Tributary</b>	<b>Net Rainfall</b>	<b>S-65E Flows</b>
<b>Condition</b>	<b>(inches past 4 weeks)</b>	<b>(cfs-2 week average)</b>
Very Dry	less than 3.00	less than 500
Dry	3.00 - 7.01	500 - 499
Normal	7.00 - 1.99	1,500 - 3,499
Wet	2.00 - 3.99	3,500 - 5,999
Very Wet	4.00 - 7.99	6,000 - 8,999
Extremely Wet	greater than 8.0	greater than 9,000

Climatic and Meteorologic Outlooks – While tributary conditions provide a good short-term indicator of potential trends in the magnitude of Lake Okeechobee inflows, the ambient conditions in the tributary basins are not the only contributing factor. Climatic and meteorological forecasts consider several longer-term (up to twelve month) regional, global, and solar indicators in helping to estimate the potential volume of water that can be expected to flow into Lake Okeechobee. As with the tributary conditions, information provided by these indices helps to determine when there is an opportunity to 'hedge' water management practices. The decision tree operational guidelines for WSE utilize three different outlooks in the decision making process: meteorologic forecast, seasonal outlook and multi-seasonal outlook. Each of these measures has an associated classification scheme for determining hydrologic regimes. In the SFWMM, monthly pre-processed non-perfect hind-cast data is input and user options define the thresholds for classification of outlooks (Table 3.1.3.3). An additional simplifying assumption is made in the model in which the meteorologic forecast is not considered and the seasonal forecast is assumed to apply in both decision boxes. This assumption is necessary due to the difficulty in deriving hind-cast meteorologic forecasts over the 1965-2000 period of simulation.

**Table 3.1.3.3** Classification of Seasonal and Multi-Seasonal Inflow Predictions

	<b>Seasonal Inflow Prediction</b>	<b>Multi-Seasonal Inflow Prediction</b>
<b>Condition</b>	<b>(Equivalent LOK Depth** in feet)</b>	<b>(Equivalent LOK Depth** in feet)</b>
Dry	< 1.1	< 1.1
Normal	1.1 – 2.1	1.1 - 3.2
Wet	2.11 – 3.2	3.21 - 4.3
Very Wet	greater than 3.2	greater than 4.3

\*\*Volume-depth conversion based on average Lake surface area of 467,000 acres

Determination of Discharges – Examining the WSE “Part 2” decision tree outcomes for discharges to tide, considerable flexibility can be observed in the final determination of discharge volumes. Several of the outcome boxes indicate releases “up to” a determined level. In real-time operations, this allows water managers to optimize the performance of the competing considerations when making regulatory discharges. In the SFWMM, simplifying assumptions are made that enable users to retain some flexibility in determining the operations associated with the decision tree outcome. For boxes that dictate a release “up to” maximum discharge or a determined steady flow, the model will always simulate the maximum allowable flow rate. In the case of decision boxes that indicate “up to maximum pulse release”, users have the option of specifying which of the three levels of pulse discharges to make to both the St. Lucie and Caloosahatchee Estuaries. Pulse releases are designed to mimic the flow pattern associated with naturally occurring rainfall events and as such should result in less impact to the estuary ecology by allowing time for recovery of the salinity envelope prior to resuming high discharge rates. Once a 10-day outflow pulse is initiated by the schedule, the release rule is continued to completion even if Lake stage drops below that pulse level. After a 10-day period is completed, the need for additional releases is re-evaluated. The pulse level values are shown in Table 3.1.3.4.

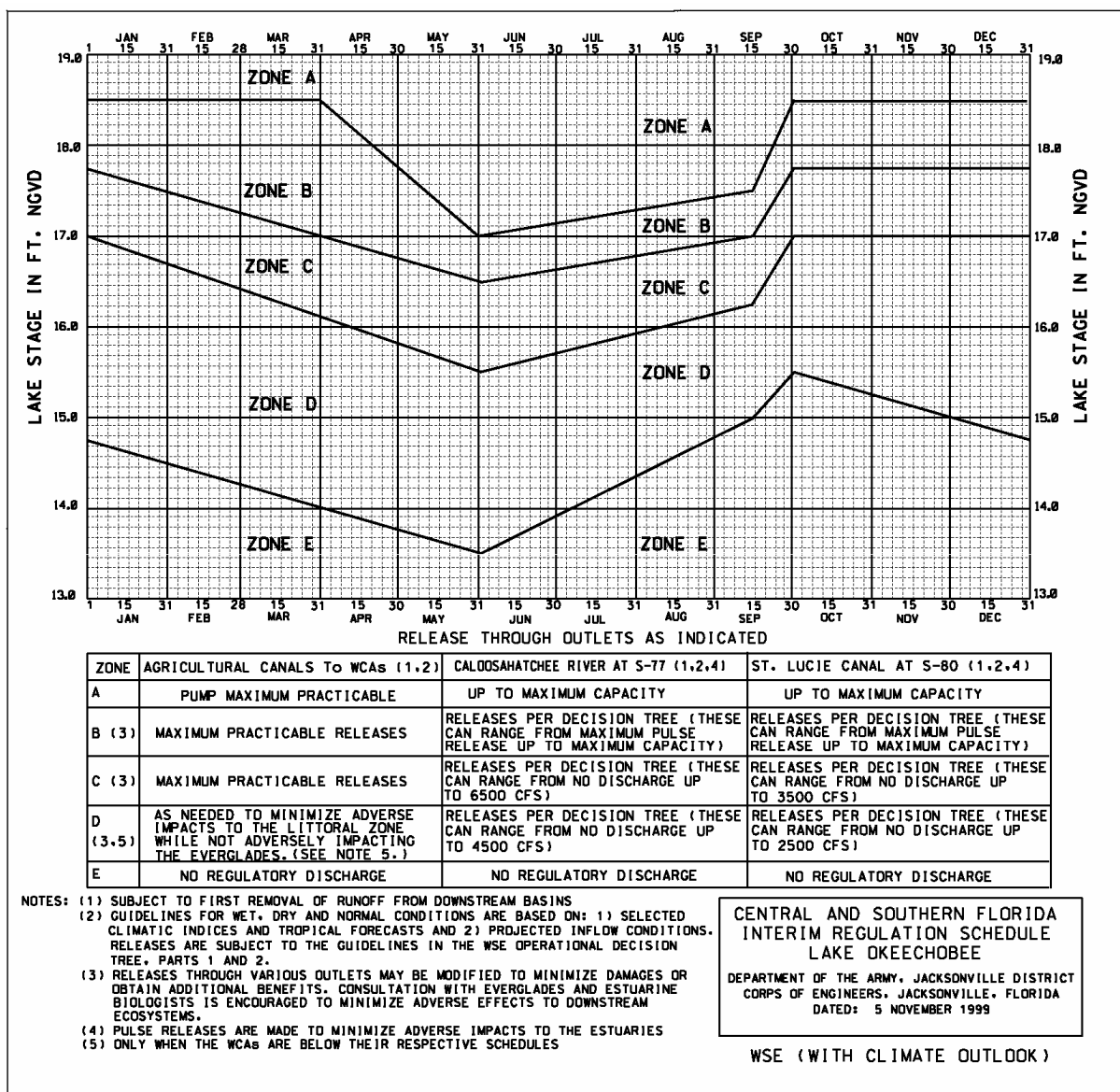
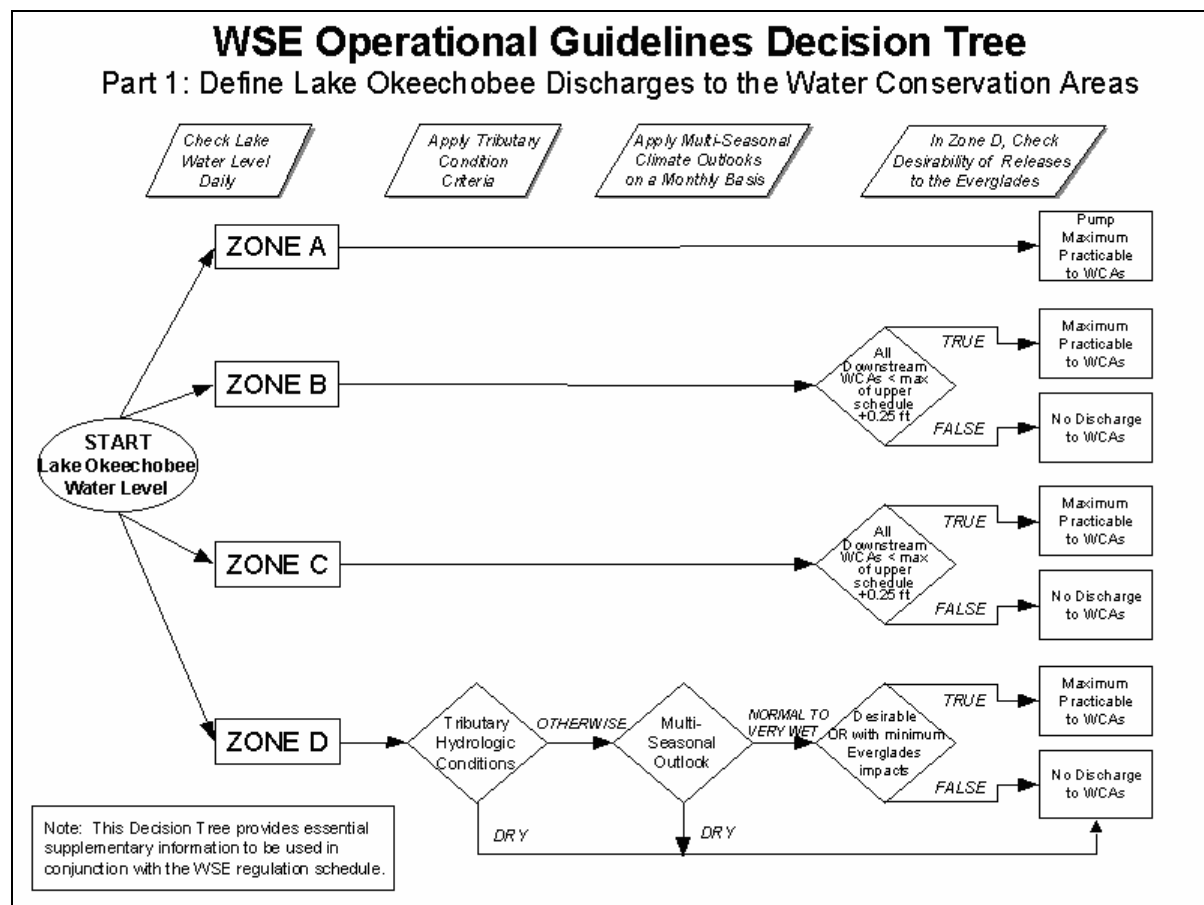


Figure 3.1.3.2 WSE Regulation Schedule

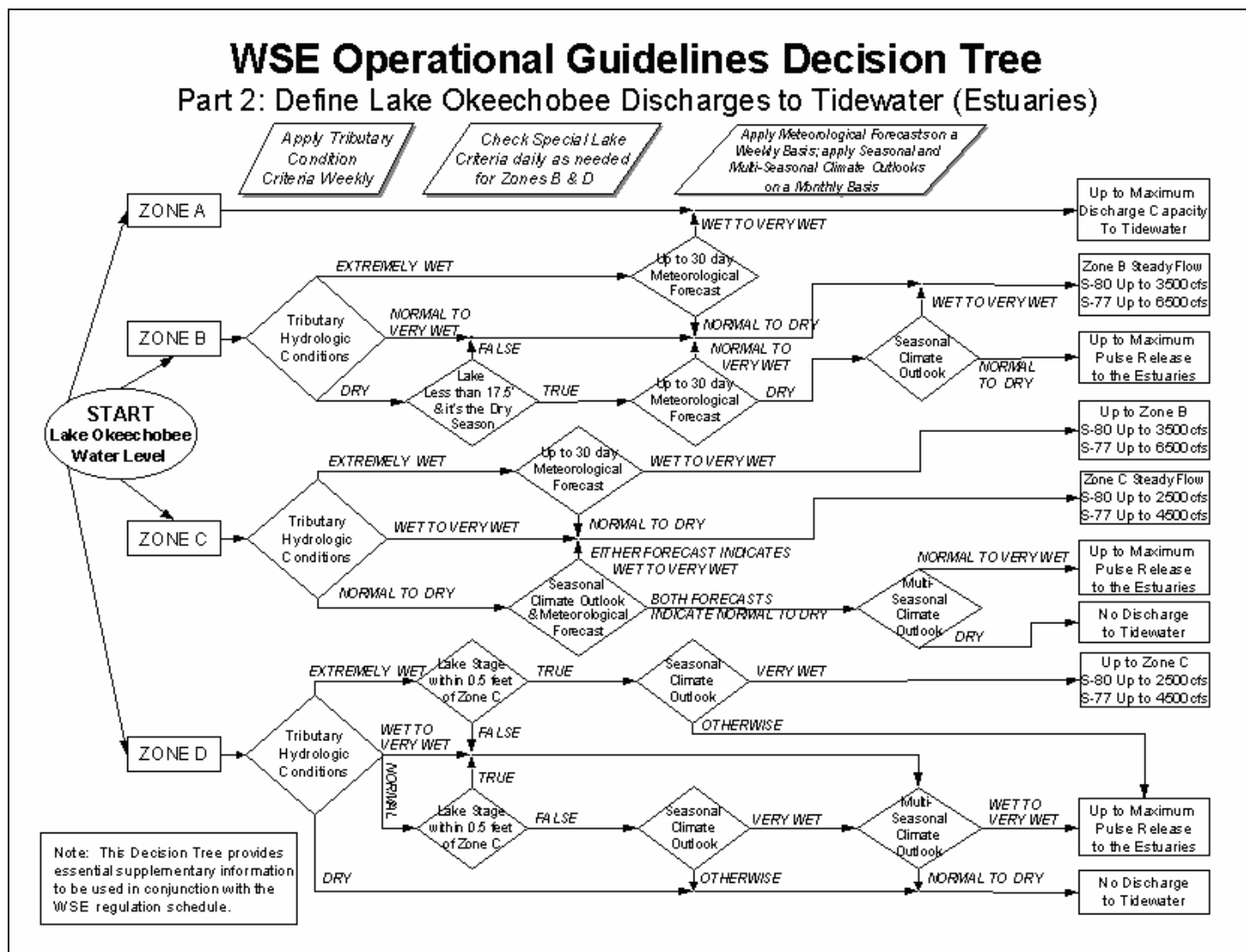
**Table 3.1.3.4** Pulse Release Hydrographs for the Three Levels of Zone D Regulation Schedule for Lake Okeechobee

DAY	St. Lucie I	St. Lucie II	St. Lucie III	Caloos. I	Caloos. II	Caloos. III
1	1,200	1,500	1,800	1,000	1,500	2,000
2	1,600	2,000	2,400	2,800	4,200	5,500
3	1,400	1,800	2,100	3,300	5,000	6,500
4	1,000	1,200	1,500	2,400	3,800	5,000
5	700	900	1,000	2,000	3,000	4,000
6	600	700	900	1,500	2,200	3,000
7	400	500	600	1,200	1,500	2,000
8	400	500	600	800	800	1,000
9	0	400	400	500	500	500
10	0	0	400	500	500	500

note: All values in cubic-feet per second.



**Figure 3.1.3.3** WSE Decision Tree for Lake Okeechobee Discharges to WCAs



**Figure 3.1.3.4** WSE Decision Tree for Lake Okeechobee Discharges to C-43 and C-44s

In addition to evaluations of different regulation schedules, the SFWMM has been used as a guide for shorter-term (less than 6 months) planning for Lake Okeechobee operations. For short-term planning, operational rules that deviate from normal may be implemented to meet short-term objectives. Flexibility is incorporated into the SFWMM so that changes in operations for Lake Okeechobee for defined periods throughout the calendar year can be simulated. These input options can be used to simulate several types of deviations, including varying the level of pulse releases and modifying breakpoints for classification for climate forecasts.

### 3.1.4 Lake Interaction with the C-43 and C-44 Basins/Estuaries

As explained in the text above, the Lake uses the C-43 Canal (Caloosahatchee River) and the C-44 Canal (St. Lucie River) as conduits for releasing regulatory flows west and east of the Lake, respectively. Additional considerations within these basins include the consumptive use water supply needs of agricultural users (as explained in Section 3.3) and the environmental water supply or flow attenuation needs of the downstream estuaries. Figure 3.1.4.1 shows a schematic diagram of the C-43 Basin/Estuary simulation module. Terms used in Figure 3.1.4.1 are defined as follows:

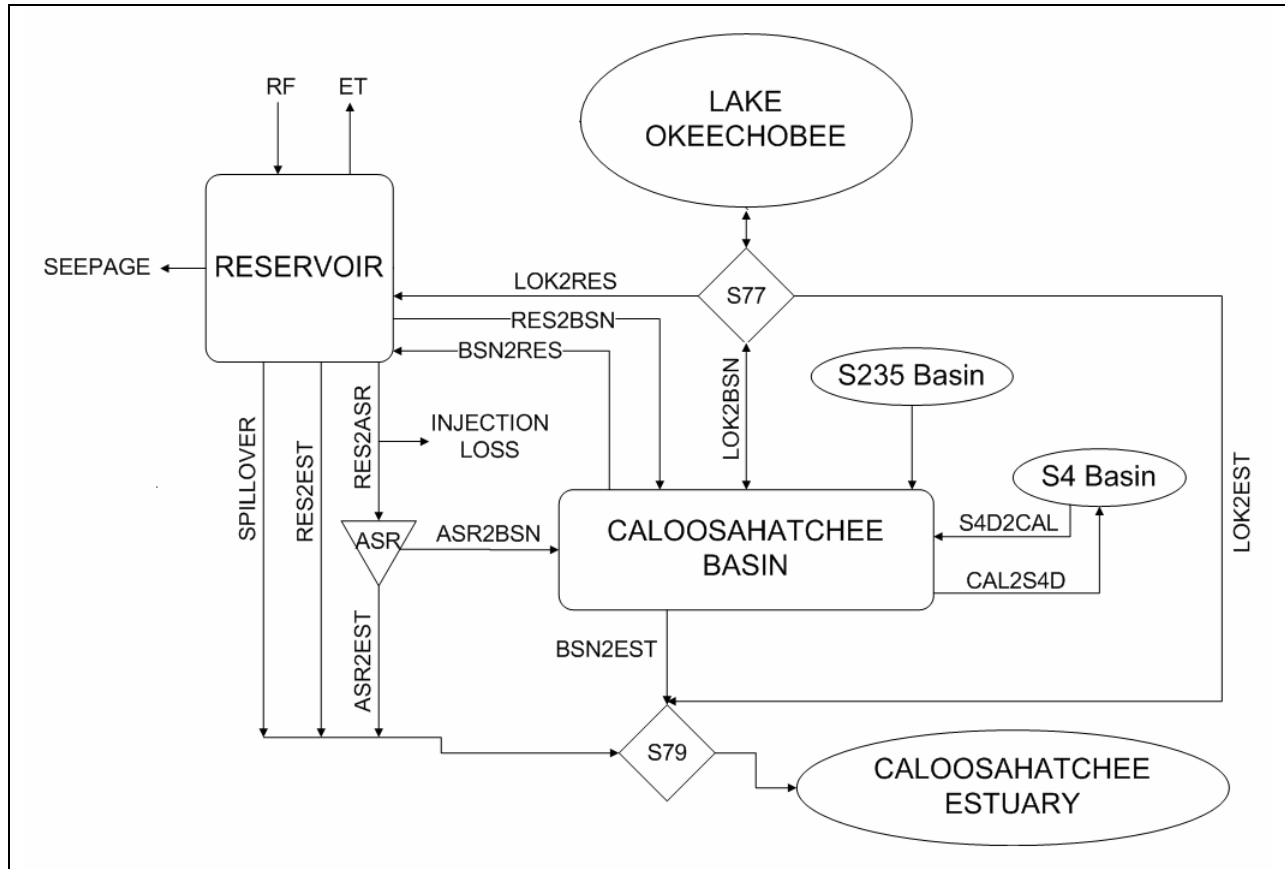
- LOK2RES = Regulatory flood control release from Lake Okeechobee (LOK) to C-43 Reservoir through S-77.
- LOK2BSN = Water supply deliveries from LOK to the C-43 Basin through S-77.
- LOK2EST = Releases from LOK to Caloosahatchee Estuary through S-77/S-79.  
Includes LOK regulatory flood control releases and environmental water supply from LOK to meet estuarine demands.
- RF = Rainfall into C-43 Reservoir.
- ET = Evapotranspiration from C-43 Reservoir.
- SEEPAGE = Seepage from C-43 Reservoir.
- SPILOVER = Spillover from C-43 Reservoir during extreme wet conditions. This excess volume is assumed to be discharged into the Caloosahatchee Estuary through S-79.
- RES2LOK = Backpumping of C-43 Reservoir runoff to Lake Okeechobee. Only allowed if LOK stage is below a certain threshold (typically 13.0 ft). S77 backflow can also occur if Lake Okeechobee is below 11.1 ft.
- RES2BSN = Water supply from C-43 Reservoir to C-43 Basin.
- BSN2RES = Runoff from C-43 Basin routed to C-43 Reservoir.
- RES2EST = Environmental water supply from C-43 Reservoir through S-79 to meet demand in Caloosahatchee Estuary. This demand is calculated at S-79 based on a prescribed flow distribution that would lead to desirable salinity envelopes within the Estuary.
- RES2ASR = Injection from C-43 Reservoir into aquifer storage and recovery facilities (ASR).
- ASR2EST = Environmental water supply from C-43 ASR through S-79 to meet demands in Caloosahatchee Estuary.
- INJECTION LOSS= ASR efficiency loss (usually assumed to be 30%).
- ASR2BSN = Water supply from C-43 ASR to C-43 Basin.
- BSN2EST = Runoff from C-43 Basin routed to the Caloosahatchee Estuary through

S-79 (may meet estuarine demands or may be excess).

S235 = S-4 Basin runoff that is routed to the C-43 Basin through S-235.

S4D2CAL = S-4 Basin runoff from the Diston Water Control District that is routed to the C43 Basin via the 9-mile Canal.

CAL2S4D = C-43 Basin runoff routed to the S-4 Basin (Diston Water Control District) via the 9-mile Canal.



**Figure 3.1.4.1** Schematic Diagram of Caloosahatchee Basin/Estuary Simulation Module

Figure 3.1.4.2 displays a schematic diagram of the C-44 Basin/Estuary simulation module. Terms used in Figure 3.1.4.2 are defined as follows:

LOK2RES = Regulatory flood control release from LOK to C-44 Reservoir through S-308.

LOK2BSN = Water supply deliveries from LOK to the C-44 Basin through S-308.

LOK2EST = Releases from LOK to St. Lucie Estuary through S-308/S-80. Includes LOK flood control regulatory releases and environmental water supply from LOK to meet estuarine demands.

RF = Rainfall into C-44 Reservoir.

ET = Evapotranspiration from C-44 Reservoir.

SEEPAGE = Seepage from C-44 Reservoir.

SPILOVER = Spillover from C-44 Reservoir during extreme wet conditions. This excess volume is assumed to be discharged into the St. Lucie Estuary through

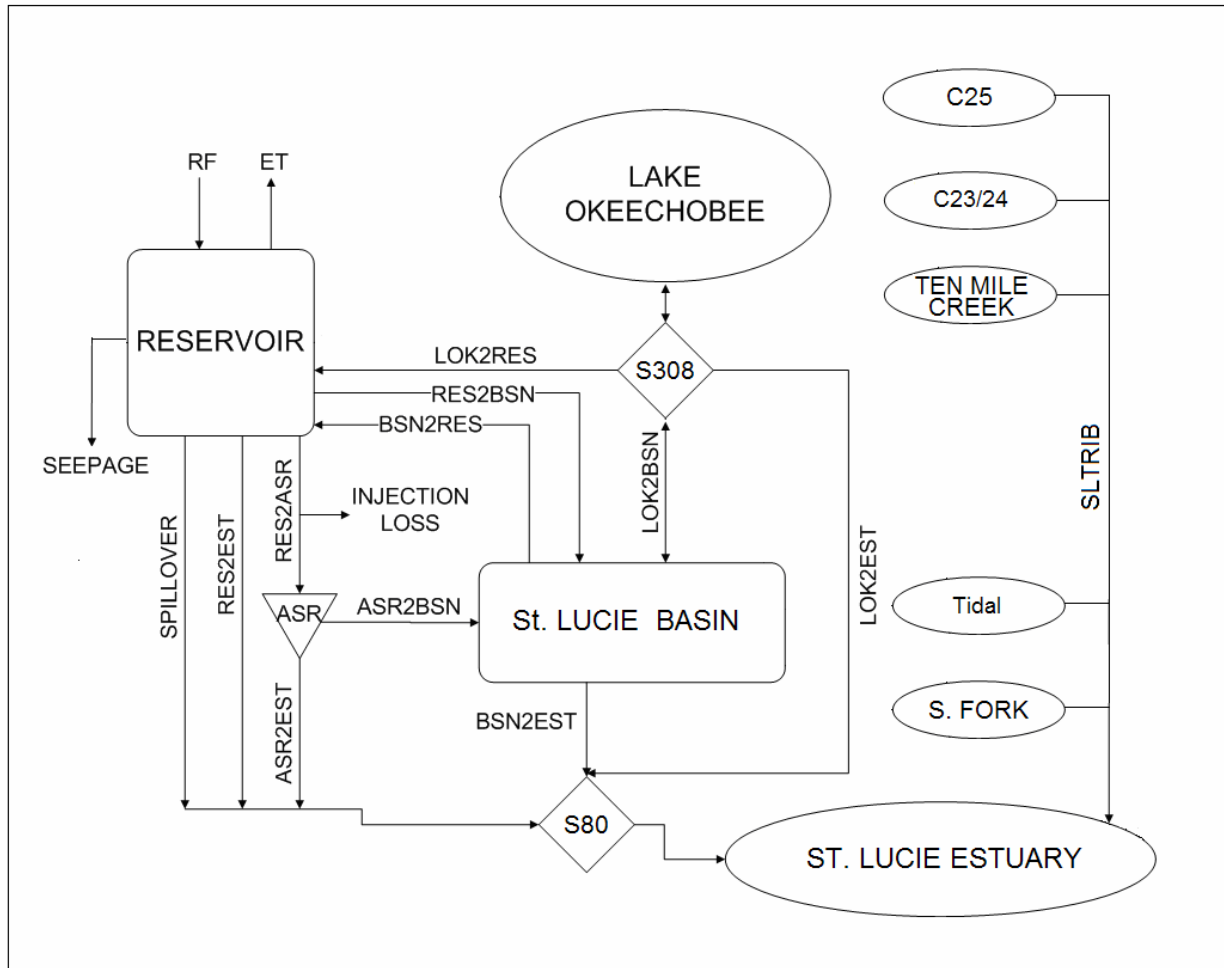
S-80.

- RES2BSN = Water supply from C-44 Reservoir to C-44 Basin.  
BSN2RES = Runoff from C-44 Basin routed to C-44 Reservoir.  
RES2EST = Environmental water supply from C-44 Reservoir through S-80 to meet minimum demand in St. Lucie Estuary. This demand is calculated at S-80 based on a prescribed flow distribution that would lead to desirable conditions (identified as salinity envelopes and biological indicators for oysters and sea grasses) within the estuary.  
RES2ASR = Injection from C-44 Reservoir into ASR facilities.  
ASR2EST = Environmental water supply from C-44 ASR through S-80 to meet demands in St. Lucie Estuary.  
INJECTION LOSS= ASR efficiency loss (usually assumed to be 30%).  
ASR2BSN = Water supply from C-44 ASR to C-44 Basin.  
BSN2EST = Runoff from C-44 Basin routed to the St. Lucie Estuary through S-80 (may meet estuarine demands or may be excess).  
SLTRIB = Runoff from tributaries of the St. Lucie Estuary including the following basins: C25, C23/C24, Ten Mile Creek, South Fork, Tidal Basin. The runoff may meet estuarine demands or may be excess.

Storage facilities such as ASRs and reservoirs in the Caloosahatchee and St. Lucie Basins currently do not exist but can be simulated as options in the model. For the Caloosahatchee and St. Lucie Basin/Estuary, the purposes of these facilities are:

1. to attenuate regulatory flows from the Lake through structure S-77 (or S-308) which would otherwise be harmful to the basin (flooding) and to the estuary (sudden lowering in salinity);
2. to provide backup source of water for satisfying irrigation needs in the basin which otherwise comes exclusively from Lake Okeechobee; and
3. to regulate inflows to the estuary from the local basin which may be deemed harmful to the ecology in the area.

The detailed steps describing the interaction between the Lake and the C-43 and C-44 Basin/Estuaries, as calculated by the SFWMM v5.5, are presented in Appendix E.



**Figure 3.1.4.2** Schematic Diagram of St. Lucie Basin/Estuary Simulation Module

### 3.1.5 Lake Management Algorithm

The overall algorithm for simulating water releases from Lake Okeechobee is given in the following pseudo-code format. This text illustration is intended to provide insight into the way that the SFWMM internally implements the complexities associated with the management alternatives described up to this point.

1. Define key gages (monitoring point and/or canal) in WCAs/ENP and corresponding reference/trigger stages. These user-input locations and values will be used in the determination of water supply need in the WCAs/ENP and in assessing the potential impacts of regulatory discharges in the WSE decision trees.
2. Compute conveyance limitations for Lake release locations. EAA canal conveyance calculations are outlined in Section 3.2. For most other structures, pump capacities or gravity discharge based on headwater/tailwater (HW/TW) are considered. All subsequent steps involving water releases from the Lake are subject to the appropriate conveyance limitations.
3. Calculate required supplemental irrigation demands (consumptive use water supply) for the entire Lake Okeechobee Service Area. Demands may be calculated within the distributed portion of the model or read-in as pre-processed data (Trimble, 1992a and

1992b). The means of calculating supplemental demands within the SFWMM are described in Sections 3.2 and 3.3. Any water shortage cutbacks to deliveries will be applied in this step.

4. Execute St. Lucie module in order to determine portion of C-44 runoff that goes into St. Lucie Estuary and into Lake Okeechobee as backflow, release from Lake Okeechobee to satisfy C-44 Basin demand and minimum St. Lucie Estuary demand, if any. In general, the module can set priorities between:
  - A. satisfying minimum St. Lucie Estuary demand (environmental delivery);
  - B. routing runoff, if any, from C-44 Basin to the Lake or to the St. Lucie Estuary or satisfying C-44 Basin demand from the Lake.
5. Execute Caloosahatchee module in order to determine portion of C-43 runoff that goes into Caloosahatchee Estuary and into Lake Okeechobee as backflow, release from Lake Okeechobee to satisfy C-43 Basin demand and minimum Caloosahatchee Estuary demand, if any. In general, the module can set priorities between:
  - A. satisfying minimum Caloosahatchee Estuary demand (environmental delivery);
  - B. routing runoff, if any, from C-43 Basin to the Lake or to the Caloosahatchee Estuary or satisfying C-43 Basin demand from the Lake.
6. Calculate non-regulatory environmental deliveries to WCAs/ENP and/or water supply flows through WCAs to LECSAs. The means of calculating water supply needs to the WCAs/ENP and the LECSAs will be discussed in detail in Sections 3.4 and 3.5, respectively. In addition to conveyance limitations as outlined in step 2, minimum water levels at canals or nodal locations can be specified in the model in order to not “overdrain” Lake Okeechobee. This option restricts the timing of releases from the Lake such that water will not be made available at a downstream location if the stage in the Lake falls below specified levels. Another option exists in the model to deliver water only on user specified days of the week (e.g. LEC on Sunday and Thursday and EAA on Monday and Friday). This option is intended to reflect the practices of system operators during periods of shortage when allocated water is delivered to individual users on specified days in order to prevent competition for water supply.
7. Update and check intermediate Lake Okeechobee stage. If stage is within the regulatory zones as input for flood control purposes (i.e., stage in Zone A, B, C or D), then make regulatory releases as dictated by trip-line operation or decision trees. Due to the magnitude of a regulatory discharge through a single conveyance canal, Lake stage may drop to a level so as to significantly influence the amount of discharge through the next conveyance canal. For this reason, the model updates Lake stage before it calculates the necessary release for the next conveyance canal in the list. The order by which releases into WCAs are made is input by the user. Structure and conveyance capacities are reduced by the amount of water already discharged for non-regulatory purposes as defined in steps 3, 4, 5 and 6. If Lake stage is within the "normal operating zone" (i.e., "Zone E"), this flood control step is skipped.
8. Update final Lake Okeechobee stage and return to main program.